

REMARKS/ARGUMENTS

The Office Action mailed February 28, 2003 has been reviewed and carefully considered. Claims 1, 8, and 9 have been amended. Claims 1-9 are pending in this application, with claims 1, 8, and 9 being the only independent claims. Reconsideration of the above-identified application, as herein amended and in view of the following remarks, is respectfully requested.

In the Office Action mailed February 28, 2003, the drawings are objected to as allegedly not showing the bipolar gradient pair, which is recited in claim 4. The specification states on page 3, lines 3-4 that a bipolar gradient pair is a pair of gradients that have the same polarity and are separated by a refocusing pulse. It is respectfully submitted that Fig. 2 shows a pair of gradients GL1 and GL2 that have the same polarity and are separated by refocusing pulse RFP, which are described on page 6, lines 16-18. Since Fig. 2 shows the bipolar gradient pair as recited in claim 4, it is respectfully requested that the objection to the drawings now be withdrawn.

The specification was objected to as not being in the preferred layout, including section headings listed in 37 CFR 1.77(b). The specification has been amended to include the appropriate headings. The title is also objected to as not being descriptive. The title has been amended to recite -- MRI Method for Correcting Amplitude of Resonance Signals --. In view of the above amendments, it is respectfully requested that the objections to the drawings now be withdrawn.

Claim 1 is objected to as not being in the proper format. Claim 1 has been amended to properly phrase the preamble, to include a transitional phrase, and to properly word the steps using the gerund form of verbs. In view of the amendments, it is respectfully requested

that the objection of claim 1 now be withdrawn. In addition, independent claims 2, 4, 8, and 9 have been amended for clarification and to put the claims in better form. In particular, claim 9 is amended to recite a computer readable medium having a computer program. Support for this amendment is found in page 4, lines 2-5.

Claims 1-2 and 7-9 stand rejected under 35 U.S.C. §102(e) as anticipated by U.S. Patent No. 6,424,153 (Liu).

Claims 3-6 stand rejected under 35 U.S.C. §103 as unpatentable over Liu.

Before discussing the cited prior art and the Examiner's rejections of the claims in view of that art, a brief summary of the present invention is appropriate. The present invention relates to a method for magnetic resonance imaging which allow accurate extraction of quantitative information from magnetic resonance signals despite non-linearities in applied temporary magnetic gradient fields. The present invention also relates to a system and computer-readable memory containing a computer program for performing the method. According to the invention, a magnetic resonance signal is generated and temporary magnetic gradient fields are applied by gradient coils 11, 12 prior to applying an imaging pulse sequence (see Fig. 2, page 4, lines 19-23, and page 6, lines 11-15). The application of the temporary magnetic gradient fields provides spatial encoding of the magnetic resonance signals (page 4, lines 33-34). The signal amplitudes of the magnetic resonance signals are corrected, wherein the correction is preferably derived by calculating the instantaneous temporary magnetic fields from data relating to the control of the magnetic resonance imaging system (page 2, lines 5-7 and lines 24-26).

Each of the independent claims has been amended to recite that each of the steps of generating the magnetic resonance signals and applying temporary magnetic gradient fields are

performed before the step of applying an imaging pulse sequence. Support for this limitation is found in Fig. 2 and on page 6, lines 11-15 of the specification.

Liu discloses a method for removal of data inconsistencies with k-space oversampling and demodulation in magnetic resonance imaging (MRI) acquisitions. According to Liu, imaging sequences of pulses are applied in an MRI apparatus which produces a plurality of imaging echoes (col. 1, line 67 - col. 2, line 3). Each echo is phase encoded and collected into k-space as data points (col. 2, lines 3-5). An additional navigator echo is generated and collected in conjunction with each of the plural image sequences (col. 2, lines 7-9 and 23-25). Sampled data points in k-space are adjusted to account for data inconsistencies based on the information gleaned from the collected navigator echoes (col. 2, lines 9-11 and 30-32). Accordingly, Liu discloses that the correction is done using navigator echoes which are applied during the application of the imaging sequences. In contrast, each of the independent claims 1, 8, and 9 expressly recites that temporary magnetic gradient fields which are used to correct the amplitude of the magnetic resonance signals are applied before the imaging sequences. Accordingly, it is respectfully submitted that Liu fails to anticipate independent claims 1, 8, and 9.

In addition, Liu also fails to disclose that the correction of the signal amplitudes of the magnetic resonance signals is calculated from the spatial and temporary electrical current distribution through a gradient coil, as recited in dependent claim 2. Instead, Liu teaches averaging all navigator echoes and comparing each individual echo with the average (col. 5, lines 48-50). All echoes in a sequence are then scaled based on the difference between its navigator echo and the average (col. 5, lines 50-52). Accordingly, Liu fails to disclose calculating the correction from the spatial and temporary electrical current through the gradient coil. Accordingly, dependent claim 2 is not anticipated by Liu for this additional reason.

Furthermore, Liu actually teaches away from the present invention because Liu states that the production of calibration or reference echoes before the imaging sequence is inefficient (see col. 1, lines 49-60). Accordingly, it is respectfully submitted that independent claims 1, 8, and 9, are also allowable over Liu.


Dependent claims 2-7, being dependent on independent claim 1, are allowable for at least the same reasons as independent claim 1.

The application is now deemed to be in condition for allowance and notice to that effect is solicited.

It is believed that no fees or charges are required at this time in connection with the present application; however, if any fees or charges are required at this time, they may be charged to our Patent and Trademark Office Deposit Account No. 03-2412.

Respectfully submitted,

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Dated: May 28, 2003